



March 24, 2008

Honorable Arnold Schwarzenegger  
Governor  
State of California  
State Capitol  
Sacramento, CA 95814

Dear Governor Schwarzenegger:

As your Delta Vision Blue Ribbon Task Force moves toward our final goal of developing a Strategic Plan to implement our vision for the Delta and the water future of California, it is increasingly clear that sea level rise is an important factor that must be taken into account. We said that in our Vision, which we submitted to you late last year.

The State of California needs a consistent approach to planning for sea level rise, the foundation of which is using common expected values in making public policy decisions. We suggested the estimates be for both 2050 and 2100.

All the evidence presented to us so far indicates that sea level rise is occurring, and will substantially impact the Delta ecosystem, decisions on when and how to build improved water conveyance facilities, and an array of diverse issues ranging from urban encroachment in the Delta to the placement of highways, power, natural gas and other infrastructure.

At our last meeting, the Blue Ribbon Task Force unanimously adopted the following motion:

- The Delta Vision Blue Ribbon Task Force recommends the Governor promptly issue an Executive Order setting assumed levels of sea level rise for 2050 and 2100, and order State agencies to incorporate these assumptions in their planning.
- The assumed levels of sea level rise should be reviewed for accuracy on a schedule adopted in the Executive Order.
- Pending issuance of the Executive Order, the Task Force adopts sea level rise assumed levels of 55 inches for 2100, to be integrated into the Strategic Plan being prepared. These assumed levels are based on the recommendation of the Delta Science Advisors rendered on September 6, 2007.

1416 Ninth Street, Suite 1311, Sacramento, CA 95814 Ph. 916.653.5656 Fax 916.653.8102 <http://resources.ca.gov>



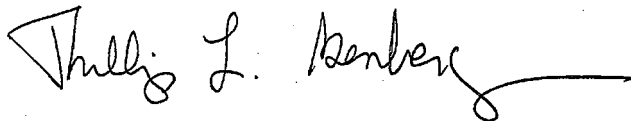
Honorable Arnold Schwarzenegger  
March 24, 2008  
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Your Executive Order S-17-06 directs us to include consideration of reliable water supply, the environment and infrastructure in developing a vision and strategic plan. All these and more will be affected by sea level rise. Just within the Delta, for example, decisions by the Department of Water Resources on design of conveyance, by the Department of Fish and Game on ecosystem restoration, by CALTRANS on highway improvements, by the California Public Utilities Commission on utilities infrastructure should address sea level rise.

We know that the scientific understanding of sea level rise is increasing rapidly. Accordingly, we are asking the Delta Science Advisors for a recommendation of assumed sea level rise for 2050 and anticipate receiving that recommendation soon. Until it is received, we will use the recommendation developed in the Delta Risk Management Strategies of 16 inches.

If we can provide more information about this recommendation, please contact me.

Sincerely,

A handwritten signature in black ink, reading "Phillip L. Isenberg". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Phillip L. Isenberg, Chair  
Delta Vision Blue Ribbon Task Force

cc: Mike Chrisman, Secretary  
Resources Agency  
1416 Ninth Street, Suite 1311  
Sacramento, CA 95814

Attachments: Delta Science Advisors Letter of September 6, 2007  
Sea Level Rise (SLR) Projections by Select State and Federal Agencies



# CALFED BAY-DELTA PROGRAM

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P. Joseph Grindstaff,  
Director

## State Agencies

### The Resources Agency:

Department of Water Resources

Department of Fish and Game

Delta Protection Commission

Department of Conservation

San Francisco Bay Conservation and  
Development Commission

California State Parks

The Reclamation Board

California Environmental  
Protection Agency:

State Water Resources Control Board

California Department of Food  
and Agriculture

California Department  
of Health Services

## Federal Agencies

### Department of the Interior:

Bureau of Reclamation

Fish and Wildlife Service

Geological Survey

Bureau of Land Management

US Army Corps of Engineers

Environmental Protection Agency

Department of Agriculture:

Natural Resources Conservation Service

Department of Commerce:

National Marine Fisheries Service

Western Area Power Administration

September 6, 2007

To: John Kirlin, Executive Director  
Delta Vision Blue Ribbon Task Force

From: Mike Healey  
CALFED Lead Scientist

## RE: PROJECTIONS OF SEA LEVEL RISE FOR THE DELTA

Recognizing that sea level rise would likely be an uncertain but contentious issue for the Delta Vision Blue Ribbon Task Force (Task Force) to address, the Science Program requested that the Independent Science Board (ISB), examine the current literature and offer comments, and if possible, recommendations on sea level rise to aid the Task Force. The response of the ISB is attached to this memo. In my opinion, the ISB has provided a very helpful summary of the extensive and confusing science around climate related sea level rise. They also make specific recommendations concerning which of the many projections of sea level rise should guide the Task Force in developing its vision.

Key points made in the ISB memo are first, that current projections of sea level rise by the Intergovernmental Panel on Climate Change (IPCC), are likely very conservative as the models used to develop these projections underestimate recent measured sea level rise. Second, extrapolation from empirical models of sea level rise yields significantly higher estimates of sea level over the next few decades than the IPCC projections. The ISB suggests that the empirical projections are probably a better basis for short to mid term planning. And third, that neither approach to estimating future sea levels takes account of melting of ice in Greenland and Antarctica, which recent studies suggest is accelerating.

Based on their analysis, the ISB suggests that a mid-range rise in sea level this century is likely to be at least 70-100 cm, significantly greater (~200 cm) if ice cap melting accelerates. While the absolute rise is alarming enough, even more alarming is the fact that only a few centimeters of sea level rise will greatly increase the frequency, intensity and duration of extreme water levels. It is these events that pose the greatest risk to Delta levees, infrastructure and private property.


The ISB assessment of rates and magnitude of sea level rise greatly increases one of the key risk factors in decisions about land use, levee integrity, water conveyance, public safety and other important considerations in the Delta Vision. In my view, it is essential that all the current planning processes take the likelihood of greater sea level rise into account. This is particularly true for the Delta Risk Management Strategy

John Kirlin  
September 6, 2007  
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(DRMS) study, which did not factor any sea level rise into its assessment of levee needs in its draft Phase 2 report.

I trust that you will convey the ISB memo to the Task Force. I will copy it to the DRMS Technical Advisory Committee, The Bay Delta Conservation Plan Steering Committee Members (BDCP), the Ecosystem Restoration Program (ERP) Implementing Agency Managers and other interested parties. Please let me know if you or the Task Force have any questions.

Sincerely,



Mike Healey  
CALFED Lead Scientist

Attachment

cc: Joe Grindstaff, Director, CALFED  
CALFED Deputy Directors  
DRMS Technical Advisory Committee  
BDCP Steering Committee Members  
ERP Implementing Agency Managers



**Independent  
Science  
Board**

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Utah State University

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University of Texas at Austin

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Montana State University

Paul Smith, Ph. D.  
University of California, San Diego

September 6, 2007

TO: Michael Healey, Lead Scientist  
CALFED Bay-Delta Program

FROM: Jeffrey Mount, Chair  
CALFED Independent Science Board

RE: Sea Level Rise and Delta Planning

In July of this year, you asked that the Independent Science Board (ISB) examine the array of sea level rise projections available in published reports and, based on current scientific understanding, advise the Science Program about which projections are most appropriate for incorporating into on-going planning for the Delta. The ISB discussed this issue at their August, 2007 meeting and have developed recommendations detailed in this memo. It is important to note that this is not an assessment of the state of sea level rise science, but is intended to highlight the large uncertainty in sea level rise projections and recommend ways to incorporate this uncertainty into planning.

Background

Sea level plays a dominant role in the San Francisco Bay-Delta. Water surface elevations and associated fluctuations due to tides, meteorological conditions and freshwater inflows drive Bay-Delta hydrodynamics. Hydrodynamics, in turn, dictate the location and nature of physical habitat, the quantity and quality of water available for export, and the design of the flood control/water supply infrastructure. Change in sea level has the potential to substantially alter Bay-Delta conditions and to constrain future management options.

Global sea level rise is a well-documented phenomenon, both in the paleoclimatic record as well as the historical record. Tidal gage records indicate that sea level during the 20<sup>th</sup> century has risen an average of 2mm/yr (.08 in) during a period of 0.7°C warming. Recent studies suggest that since 1990, global sea level has been rising at a rate of approximately 3.5 mm/yr (.14 in/yr)<sup>1</sup>. The cause of sea level rise stems from two processes: 1) thermal expansion of sea water as the surface layer warms, and 2) increase in mass of sea water associated with melting of land-based glaciers, snowfields and ice sheets.

Recent research supported by the California Energy Commission<sup>2</sup> (CEC) and continued under the CALFED-sponsored CaSCADE program, shows that sea level

<sup>1</sup> Church, J.A and N.J. White 2006 *A 20<sup>th</sup> Century Acceleration in Global Sea-Level Rise* Geophysical Research Letters, v. 33, article no. L01602

<sup>2</sup> Cayan, D. *et al.* 2006 *Projecting Future Sea Level* California Climate change Center White Paper CEC-500-2005-202-SF Accessed at <http://www.climatechange.ca.gov/research/climate/projecting.html>

rise will impact the Delta principally by increasing the frequency, duration and magnitude of water level extremes. These extreme events occur at various periodicities and are associated with high astronomical tides and Pacific climate disturbances, such as El Niño. The CEC study showed that under moderate climate warming and a sea level rise of 3 mm/year (12 in./century), extreme high water events in the Delta--those that exceed 99.99% of historical high water levels and severely impact levees--increases from exceptionally rare today to an average of around 600 hours/year by 2100. This work also showed that roughly 100 of these hours would coincide with very high runoff conditions, further amplifying the impacts of sea level rise. In sum, even under modest sea level rise and climate warming projections, extreme high water levels that are considered rare today will likely be very common by the end of this century.

#### Sea Level Rise Projections

Early in 2007, the Intergovernmental Panel on Climate Change (IPCC) released its latest assessment of the scientific basis for projections of future climate conditions, including global average sea level rise<sup>3</sup>. As noted in the press, in comparison with the IPCC's 2001 assessment, the latest sea level rise projections appear to have narrowed the range of potential sea level rise and lowered the magnitude of projected sea level rise. This was viewed by some outside of the IPCC as indication that: 1) uncertainty regarding sea level rise had decreased and 2) the problem of sea level rise itself appeared to be less than originally stated. However, both the methods used to derive the IPCC 2007 sea level projections, along with extensive new published research in 2007 suggest that this more optimistic view of future sea level rise may be unwarranted.

The IPCC projections are based on physical models that attempt to account for thermal expansion of the oceans and storage changes in land-based glaciers and ice fields. These models, by necessity, simplify the complex processes of ocean circulation and ice melting. The IPCC midrange projection for sea level rise this century is 20-43 cm (8-17 inches), with a full range of variability of 18-59 cm (7-23 inches). The range of variability reflects model differences and uncertainties as well as differences in greenhouse gas emission scenarios. The IPCC model effort is consensus-based, reflecting the agreement of numerous international scientists.

During the past year, there have been major advances in the science of sea level rise. Paradoxically, these advances have increased the uncertainty of projections in sea level rise, at least temporarily. These advances have also led to strong criticism of the approach that the IPCC used in establishing its projections<sup>4</sup>. One criticism is that the models used to project sea level rise tend to under-predict historical sea level rises, most notably failing to capture recent increases. Indeed, models that use empirical historical relationships between global temperatures and sea level rise perform better

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<sup>3</sup> IPCC 2007 *Climate Change 2007: The Physical Basis—Summary for Policymakers* Accessed at <http://www.ipcc.ch/SPM2feb07.pdf>

<sup>4</sup> summary in Kerr 2007 *Science NOW* Accessed at <http://Sciencenow.sciencemag.org/cgi/content/full/2007/215/2>

than the IPCC 2007 models<sup>5</sup>. When applied to the range of emission scenarios used by IPCC 2007, empirical models project a mid-range rise this century of 70-100 cm (28-39 in.) with a full range of variability of 50-140 cm (20-55 in.), substantially higher than IPCC 2007 projections. However, foremost among the criticisms is the failure of the IPCC to include dynamical instability of ice sheets on Greenland and Antarctica in their projections for sea level rise.

Melting of the ice sheets of Greenland and Antarctica has the potential to raise sea level 70 m. For most of the 20<sup>th</sup> century, the ice sheets have remained relatively stable, with melting contributing a minor fraction to sea level rise. However, during the past year numerous studies have demonstrated that the mass balance (input from snowfall versus losses due to melting or detachment) of these ice sheets is shifting toward more rapid loss, most likely in response to warming of the atmosphere and oceans<sup>6</sup>. The recent rate of mass loss in these ice sheets exceeds current physical model predictions. As many authors have pointed out, increased rates of ice sheet flow involving meltwater lubrication of the ice sheet bed or the removal of buttressing ice shelves, may be accelerating the rate of ice loss on Antarctica and Greenland. The IPCC 2007 report explicitly chose not to incorporate the uncertainty associated with this process into their sea level projections. Recent publications that have examined this issue suggest that, under business as usual emissions scenarios, dynamical instability of ice sheets may add as much as 1 m (39.4 in) to sea level rise by 2100<sup>7</sup>.

#### Recommendations

The ability of current physical models to project sea level rise are limited. This stems in part from our poor understanding of and current inability to model the response of Greenland and Antarctic ice sheets to atmospheric and oceanic warming. Given the costs associated with levee failure in the Delta, the ISB feels it would be a mistake for the various planning processes now underway (BDGP, Delta Vision, DRMS) to base their planning on the conservative 2007 IPCC estimates of sea level rise. Although there is some disagreement about mechanisms of ice sheet disintegration, current advances in understanding coupled with new physical measurements all point toward the same conclusion: dynamical instability of ice sheets will likely contribute significantly to future sea level rise, with the potential for very rapid increases of up to a meter (39.4 in.) by 2100 from ice sheets alone. For this reason, the range of sea level projections based on greenhouse gas emission scenarios contained in the IPCC 2007 report should be viewed, at best, as minima for planning purposes.

The board recommends that planning efforts use three approaches to incorporate sea level rise uncertainty. First, given the inability of current physical models to accurately simulate historic and future sea level rise, until future model refinements

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<sup>5</sup> Rahmstorf, S 2007 *A Semi-Empirical Approach to Projecting Sea-Level Rise* Science v. 315, pp. 368-370.

<sup>6</sup> Shepherd, A. and D. Wingham 2007 *Recent Sea-Level Contributions of the Antarctic and Greenland Ice Sheets* Science, v. 315, pp. 1529-1532.

<sup>7</sup> Hansen J et al 2007 *Dangerous human-made interference with climate: a GISS modelE study* Atmospheric Chemistry and Physics, v. 7, pp.2287-2312.

are available, it is prudent to use existing empirically-based models for short to medium term planning purposes. The most recent empirical models project a mid-range rise this century of 70-100 cm (28-39 in.) with a full range of variability of 50-140 cm (20-55 in.). It is important to acknowledge that these empirical models also do not include dynamical instability of ice sheets and likely underestimate long term sea level rise. Second, we recommend adopting a concept that the scientific and engineering community has been advocating for flood management for some time. This involves developing a system that can not only withstand a design sea level rise, but also minimizes damages and loss of life for low-probability events or unforeseen circumstances that exceed design standards. Finally, the board recommends the specific incorporation of the potential for higher-than-expected sea level rise rates into long term infrastructure planning and design. In this way, options that can be efficiently adapted to the potential for significantly higher sea level rise over the next century will be favored over those that use "fixed" targets for design. After all, the current debates over uncertainty in sea level rise are less about how much rise is going to occur and more about when it is going to occur.



## Sea Level Rise (SLR) Projections Cited or Produced by Select State and Federal Agencies Working in California

This document is based on publicly available materials produced by respective agencies. It has not yet been reviewed by these agencies. Comments and improvements are requested, and can be sent to Dorian Fougères, [fougeres@gmail.com](mailto:fougeres@gmail.com)

Agency	Year	Report	Range of Projected SLR	Source of Projection or Prior Citation
<b>Air Resources Board (CalEPA)</b>	n/a	no estimate cited in “Climate Change Backgrounder,” and the scoping plan for implementing AB 32 (Nunez), EO # S-03-05, and AB 1493 (Pavley) is under development <a href="http://www.arb.ca.gov/cc/factsheets/ccbackground.pdf">http://www.arb.ca.gov/cc/factsheets/ccbackground.pdf</a>	-	-
<b>CALFED Bay-Delta Program</b>	2007	“Sea Level Rise and Delta Planning.” Memorandum of the Independent Science Board to the Lead Scientist. September 6, 2007. <a href="http://calwater.ca.gov/science/pdf/isb/meeting_082807/ISB_response_to_is_s_ea_level_090707.pdf">http://calwater.ca.gov/science/pdf/isb/meeting_082807/ISB_response_to_is_s_ea_level_090707.pdf</a>	<b>19.7-55.1</b> inches (50-140 cm) by 2100 at minimum	empirical model results published since IPCC 2007 Third Asmt. Report
<b>California Climate Change Center (California Energy Commission PIER)<sup>i</sup></b>	2006	<u>Projecting Future Sea Level</u> . Cayan, D., P. Bromirski, K. Hayhoe, M. Tyree, M. Dettinger, and R. Flick. <a href="http://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2005-202-SF">http://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2005-202-SF</a>	<b>4.3-28.3</b> inches (11-72 cm) higher relative to 2000 levels by 2070-2099 period, <b>2.4-12.6</b> inches (6-32 cm) by <b>2050</b>	Two climate models and three scenarios
	2006	<u>Our Changing Climate: Assessing the Risks to California (A Summary Report form the CCCC)</u> . <a href="http://www.climatechange.ca.gov/biennial_reports/2006report/index.html">http://www.climatechange.ca.gov/biennial_reports/2006report/index.html</a>	<b>22-35.4</b> inches (56-90 cm) by 2100	no citation given
<b>Caltrans</b>	2006	<u>Climate Action Program at Caltrans</u> . California Department of Transportation. Available online at <a href="http://www.dot.ca.gov/hq/tpp/offices/opar/climate_files/ClimateReport.pdf">http://www.dot.ca.gov/hq/tpp/offices/opar/climate_files/ClimateReport.pdf</a>	-	gives no numerical estimate, but cites Climate Action Team
<b>Climate Action Team<sup>ii</sup></b>	2006	<u>Final Report to the Governor and Legislature</u> . Sacramento. <a href="http://www.climatechange.ca.gov/climate_action_team/reports/2006-04-03_FINAL_CAT_REPORT.PDF">http://www.climatechange.ca.gov/climate_action_team/reports/2006-04-03_FINAL_CAT_REPORT.PDF</a>	<b>3.9-33.1</b> inches (10-84 cm) by 2100	Cayan et al 2006

Agency	Year	Report	Range of Projected SLR	Source of Projection or Prior Citation
Coastal Commission	2001	<u>Overview of Sea Level Rise and Some Implications for Coastal California</u> . Staff report to the Commission. <a href="http://www.coastal.ca.gov/climate/SeaLevelRise2001.pdf">www.coastal.ca.gov/climate/SeaLevelRise2001.pdf</a>	35.4 inches (90 cm) by 2100, 11.8 inches (30 cm) by 2050 (no low ends given)	IPCC First Asmt Report (1990), Titus and Narayanan 1995 ( <u>The Probability of SLR</u> , USEPA)
Coastal Conservancy	n/a	no cited or published estimate	-	-
Dept. of Boating & Waterways	n/a	no cited or published estimate	-	-
Dept. of Fish & Game	n/a	no cited or published estimate	-	-
Dept. of Parks & Recreation	n/a	no estimate cited in "California State Parks' Response to Climate Change." (2 pp.) <a href="http://ohv.parks.ca.gov/pages/1140/files/09-11-07revisedohmvr%20commission%20climate%20change%20synopsis.pdf">http://ohv.parks.ca.gov/pages/1140/files/09-11-07revisedohmvr%20commission%20climate%20change%20synopsis.pdf</a>	-	-
Dept. of Water Resources (Resources Agency)	2006	"Progress on Incorporating Climate Change into Management of California's Water Resources." <u>Journal of Climatic Change</u> , Special Issue. Article co-produced with the US Bureau of Reclamation. <a href="http://baydeltaoffice.water.ca.gov/climatechange.cfm">http://baydeltaoffice.water.ca.gov/climatechange.cfm</a>	3.5-34.6 inches (9-88 cm) by 2100	<b><u>IPCC Third Asmt Report (TAR, 2001)</u></b> – the entire range they give is: 3.5-34.6 inches between 1990-2100, with rise of 1.2-5.5 (3-14 cm) for 1990-2025 and 2-12.6 inches (5-32 cm) for 1990-2050
	2007	"Topical Area: Climate Change, Draft 2." <u>Technical Memorandum: Delta Risk Management Strategy Phase 1</u> . URS Corporation/Jack R. Benjamin & Associates, for DWR. <a href="http://www.drms.water.ca.gov/docs/Climate_Change_TM_Revised-updated07.pdf">http://www.drms.water.ca.gov/docs/Climate_Change_TM_Revised-updated07.pdf</a>	7.9-55.1 inches (20-140 cm) by 2100, 4.3-16.1 (11-41 cm) by 2050	a combination of IPCC TAR, Rahmstorf 2007, and linear extrapolation

Agency	Year	Report	Range of Projected SLR	Source of Projection or Prior Citation
Ocean Protection Council (Resources Agency)	2007	"Resolution of the California Ocean Protection Council on Climate Change." <a href="http://www.resources.ca.gov/copc/">http://www.resources.ca.gov/copc/</a>	22-35.4 inches (56-90 cm) by 2100	California Climate Change Center ( <u>Our Changing Climate</u> )
NOAA's National Marine Fisheries Service SW Regional Office	2007	<u>Viability Criteria for Steelhead of the South-Central and Southern California Coast</u> . Boughton, D., et al. NOAA Technical Memorandum NMFS, March 2007 <u>Draft</u> . <a href="http://swfsc.noaa.gov/uploadedFiles/Divisions/FED/Endangered_Species_Act/Salmon_TRTs/Viab05.pdf">http://swfsc.noaa.gov/uploadedFiles/Divisions/FED/Endangered_Species_Act/Salmon_TRTs/Viab05.pdf</a>	Notes " <i>medium</i> greenhouse gas-scenarios project a rise of <b>13.4-15</b> inches (34-38 cm) by 2100"	Raper, S., and R. Braithwaite. (2006) "Low Sea Level Rise Projections from Mountain Glaciers and Icecaps under Global Warming." <u>Nature</u> 439: 311-13.
Scripps Institute of Oceanography, UC San Diego	2008 (2006)	Cayan., D., P. Bromirski, K. Hayhoe, M. Tyree, M. Dettinger, R. Flick. "Climate Change Projections of Sea Level Extremes along the California Coast." <u>Climatic Change</u> 87 (Suppl 1): S57-S73. <i>Article submitted Aug. '06, Accepted Oct. '07, Published Jan. '08</i> <a href="http://www.drms.water.ca.gov/docs/SeaLevel_ClimaticChange-Cayan_etal.pdf">http://www.drms.water.ca.gov/docs/SeaLevel_ClimaticChange-Cayan_etal.pdf</a>	<b>4.3-28.3</b> inches (11-72 cm) by the 2070-2099 period	combination of global climate models, observations of actual SLR, and separate calculations from a simple climate model
San Francisco Bay Conservation & Development Commission	2007	Climate Change Planning Project (maps of the Bay and shoreline illustrating 1m SLR) <a href="http://www.bcdc.ca.gov/index.php?cat=56">http://www.bcdc.ca.gov/index.php?cat=56</a>	<b>3.9-35.4</b> inches (10-90 cm) by 2100	IPCC TAR and California Climate Change Center 2006 report
	2007	<u>Analysis of a Tidal Barrage at the Golden Gate</u> . (K. Conti). Unpublished report to the Commission. <a href="http://www.bcdc.ca.gov/pdf/planning/Golden_Gate_Dam_Report.pdf">www.bcdc.ca.gov/pdf/planning/Golden_Gate_Dam_Report.pdf</a>	"nearly <b>39.4</b> inches (1 m) by 2100" (no low end given)	no citation given
	1988	<u>Sea Level Rise: Predictions and Implications for San Francisco Bay</u> . Staff report to the Commission. <a href="http://www.bcdc.ca.gov/pdf/planning/cc_slr_rpt_1988.pdf">www.bcdc.ca.gov/pdf/planning/cc_slr_rpt_1988.pdf</a>	5 feet by 2100 (no low end given)	National Research Council (1987) <u>Responding to Changes in Sea Level</u>

Agency	Year	Report	Range of Projected SLR	Source of Projection or Prior Citation
State Water Resources Control Board (CalEPA)	n/a	no cited or published estimate	-	-
Public Utilities Commission	n/a	no cited or published estimate	-	-
US Army Corps of Engineers	n/a	no cited or published estimate in either San Francisco, Sacramento, or Los Angeles District	-	-
US Bureau of Reclamation, Mid-Pacific Region	n/a	no cited or published estimate	-	-
US Climate Change Science Program (USEPA is lead agency)	<i>not yet released</i>	Coastal Elevations and Sensitivity to Sea Level Rise – final report (Synthesis & Assessment Product 4.1) estimated release in June 2008 <a href="http://www.climatechange.gov/Library/sap/sap4-1/default.php">http://www.climatechange.gov/Library/sap/sap4-1/default.php</a>	-	-
US Environmental Protection Agency	current	website: Climate Change – Science – Future Climate Change – Future Sea Level Changes ( <a href="http://epa.gov/climatechange/science/futureslc.html">http://epa.gov/climatechange/science/futureslc.html</a> )	<b>7.1-23.2</b> inches (18-59 cm) by 2100, though notes that linear increase in ice flow would mean <b>31.1</b> inches (79 cm)	IPCC AR4
US Fish & Wildlife Service Region 8 (CA & Nevada)	n/a	no cited or published estimate	-	-
US Geological Survey	2008	Meeting in Menlo Park on SLR <a href="http://soundwaves.usgs.gov/2008/01/meetings.html">http://soundwaves.usgs.gov/2008/01/meetings.html</a>	<b>7.1-23.2</b> inches (18-59 cm) by 2100 noted as conservative, cites estimates of <b>19.7-55.1</b> inches (50-140 cm)	For <b>7.1-23.2</b> : IPCC Fourth Asmt Report (AR4), for <b>19.7-55.1</b> : Ramstorf (2007) and Real Climate (2007) <sup>iii</sup>

Agency	Year	Report	Range of Projected SLR	Source of Projection or Prior Citation
	2007	Award-winning <i>journal article</i> by 2 USGS researchers and a Berkeley professor: “Process-based empirical prediction of landslides in weakly lithified coastal cliffs, San Francisco.” In <u>Proc. of Intl. Conf. on Landslides and Climate Change</u> . R. McInnes et al., eds. Isle of Wight, UK, May 2007. 175-84. <a href="http://www.coastalwight.gov.uk/Conference%20pages/PDFs/presentations/session3/Collins.pdf">www.coastalwight.gov.uk/Conference%20pages/PDFs/presentations/session3/Collins.pdf</a>	<b>4.3-28.3</b> inches (11-72 cm) by 2100	California Climate Change Center’s <u>Projecting Future Sea Level</u> (2006)
	2005	<u>Coastal Vulnerability Assessment</u> of (1) Channel Islands National Park, (2) Golden Gate National Recreation Area, and (3) Point Reyes National Seashore to SLR. E. Pendleton, E. Thieier, and S. Williams. Reston, VA: USGS. (3 reports) <a href="http://pubs.usgs.gov/of/2005/1057/">http://pubs.usgs.gov/of/2005/1057/</a> 1058 and 1059	<b>18.9</b> inches (48 cm) by 2100 (no low end given)	IPCC (TAR, 2001)
	<b>2000</b>	<u>National Assessment of Coastal Vulnerability to Sea-Level Rise: Preliminary Results for the US Pacific Coast</u> . <a href="http://pubs.usgs.gov/of/of00-178/">http://pubs.usgs.gov/of/of00-178/</a>	<b>5.9-37.4</b> inches (15-95 cm) by 2100, “best estimate” of <b>19.7</b> inches (50 cm) by 2100	IPCC Second Asmt. Report (SAR, 1995)

**Total range for 2100: 3.5-55.1 inches**

**Total range for 2050: 2.4-16.1 inches**

<sup>i</sup> The California Climate Change Center was tasked by the Legislature with conducting and publishing research on the implications of global warming on California’s climate. The California Energy Commission’s Public Interest Energy Research (PIER) Program supports energy research and development projects that will help improve the quality of life in California by bringing environmentally safe, affordable and reliable energy services and products to the marketplace. One area of special interest to California is energy-related environmental research focusing on climate change and greenhouse gases.

<sup>ii</sup> The Climate Action Team was created by Executive Order # S-3-05, is headed by the Secretary of CalEPA, and also includes the (1) Secretary of the Business, Transportation and Housing Agency, (2) Secretary of the Department of Food and Agriculture, (3) Secretary of the Resources Agency, (4) Chairperson of the Air Resources Board, (5) Chairperson of the Energy Commission and (6) President of the Public Utilities Commission. The first report to the Governor and Legislature was released in March 2006, and is to be issued biennially thereafter.

<sup>iii</sup> Rahmstorf, S., *et al.* (2007) “Recent Climate Observations Compared to Projections.” Science 316: 709. Real Climate Website (“Climate Science from Climate Scientists”) (2007) “The IPCC Sea Level Numbers.” Post on March 27, 2007, by Stefan Rahmstorf, physicist and oceanographer with the Potsdam Institute for Climate Impact Research, member of the Advisory Council on Global Change of the German government and of the Academia Europaea, and a lead author for the paleoclimate chapter of the IPCC Assessment Report 4.